Chapter 13
History Debugged

Daniel Rosenberg

What does computer work have to say to people outside of computer fields? In what ways do computer fields draw on and contribute to broader intellectual and cultural streams? These are crucial questions today when lives are lived so much in electronic mediation. But they are not new. Questions in information design have played a role in the humanities as long as there have been humanities, from the earliest indexes and diagrams through to Memex, on the cusp of the digitized world we know (Fig. 13.1).

The problem of the relationship between coding and thinking has always been central to the work of Theodor Holm Nelson, and a key aspect of his influence both inside and outside computer fields has been his unwavering insistence on the epistemological consequences of this relationship, often discussed under the rubric he calls "systems humanism." While there is every reason to read Nelson as a figure in the modern history of information theory and design, there are as many reasons to read him in the stream of the contemporary humanities. More concretely, there are excellent reasons to consider Nelson's work—from his earliest efforts such as the literary journal, *Nothing*, through to his visionary samizdat manifesto, *Computer Lib/Dream Machines*, and his recent work reconceptualizing the spreadsheet—as a guide to the universe of paper as it is to that of the screen.

Before I plunge into history before our time, I want to very briefly recall my own first encounter with Ted Nelson's work. It was the late 1990s, an eventful time for computers and for the Internet, days when the phrase "to Google" still merited quotation marks. My own work at that time revolved around the futurisms of eighteenth-century French philosophers and writers, including Denis Diderot (1713–1784), Jean le Rond d'Alembert (1717–1783), Anne-Robert Jacques Turgot (1727–1781), and Louis-Sébastien Mercier (1740–1814), among others.

D. Rosenberg (✉)
Clark Honors College, University of Oregon, 1293, Eugene, OR 97403-1293, USA
e-mail: dbr@uoregon.edu

D.R. Dechow, D.C. Struppa (eds.), *Intertwingled*, History of Computing,
DOI 10.1007/978-3-319-16925-5_13

Fig. 13.1 Ted Nelson's Desk. From Nelson, *Computer Lib/Dream Machines* (Courtesy of Theodor Holm Nelson)

That particular year, I had a postdoctoral fellowship at the University of California Humanities Research Institute in Irvine, and my intention was to use the time to write exclusively about the eighteenth century world—and it remained my intention right up until I encountered Ted Nelson's work for the first time, which took me through a garden of forking paths.

That year, I spent a lot of time trying to understand what was happening in the electronic world around me. Imperceptibly at first, my interest in the futurism of the eighteenth century bonded with that of the emergent Web. This also led me to encounter Nelson's work and to a surprising, gratifying, and sustained engagement with it. The research that I published as a result, in a volume entitled *Histories of the Future* [5], was dedicated to Nelson's work (Fig. 13.2).

In the late 1990s, of course, there was much fevered talk about how the world was changing with the advent of new information technologies in general and with the Web in particular. It is not hard to recall the overheated rhetoric of that moment. By the way, I can assure you that one of the many not-new things about our electronic world is its feeling of world-shaking novelty. Here is what Jean-Baptiste Suard (1732–1817), a journalist associate of the French Encyclopedists, had to say about the famous print encyclopedia of Diderot and d'Alembert published between 1751 and 1772:

> What a moment and what an era [the *Encyclopédie*] promised! . . . It was as though its wishes for the human race showed divine force. . . . Nearly drunk with so much hope for the progress of reason, it prophesied a Jerusalem of philosophy that would last more than 1,000 years.[1]

[1] P.-J. Garat, *Mémoires historiques sur la vie de M. Suard* (1820), quoted in Daniel Rosenberg, "An Eighteenth-Century Time Machine," in Daniel Gordon, ed., *Postmodernism and the Enlightenment*

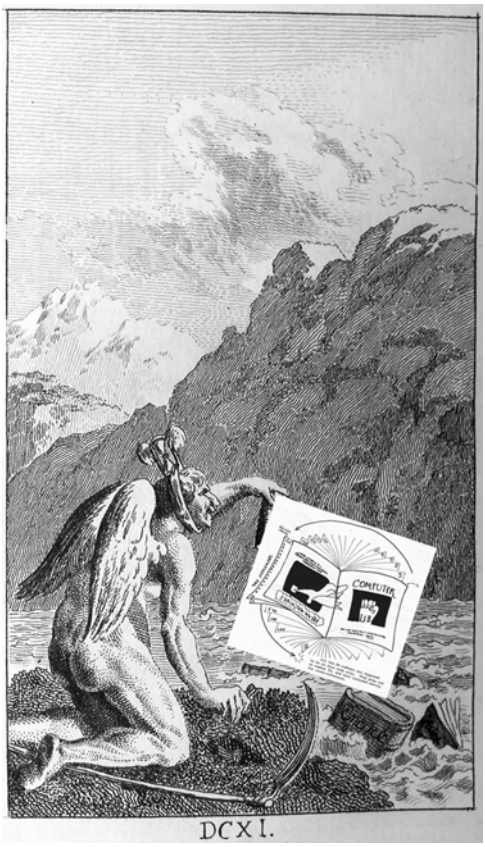


Fig. 13.2 In a distant future, an angel rescues Ted Nelson's book from the flood of time. (Adapted from Theodor Holm Nelson Computer Lib/Dream Machines and Balthasar Anton Dunker, Costumes des moeurs et de l'esprit françois avant la grande Révolution à la fin du dix-huitième (1791)). (Credit: Courtesy of Bibliothèque cantonal et universitaire - Lausanne, Switzerland.)

As a reader of eighteenth-century philosophy, literature, and science, the hyperbole of the early age of the Web was nothing if not familiar. Indeed, the echoes of this past were uncanny.

All of which was also somewhat confusing, that is, until I encountered Nelson's books. An iconic image from Nelson's earlier work is shown in Fig. 13.3. Its caption, "everything is deeply intertwingled," is of course, the fulcrum of the current consideration of Nelson's work. And here is something Nelson wrote about it:

> Within bodies of writing, everywhere, there are linkages we tend not to see. The individual document, at hand, is what we deal with; we do not see the total linked collection of them all at once. But they are there, the documents not present as well as those that are, and the grand cat's-cradle among them all. [3]

(New York: Routledge, 2001), 49, and in Bronislaw Backzko, *Utopian Lights: The Evolution of the Idea of Social Progress*, trans. Judith L. Greenberg (New York: Paragon, 1989), 31.

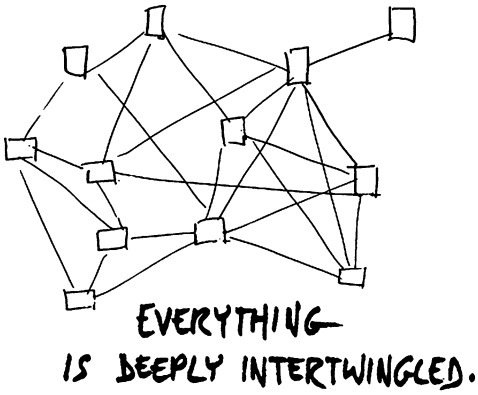


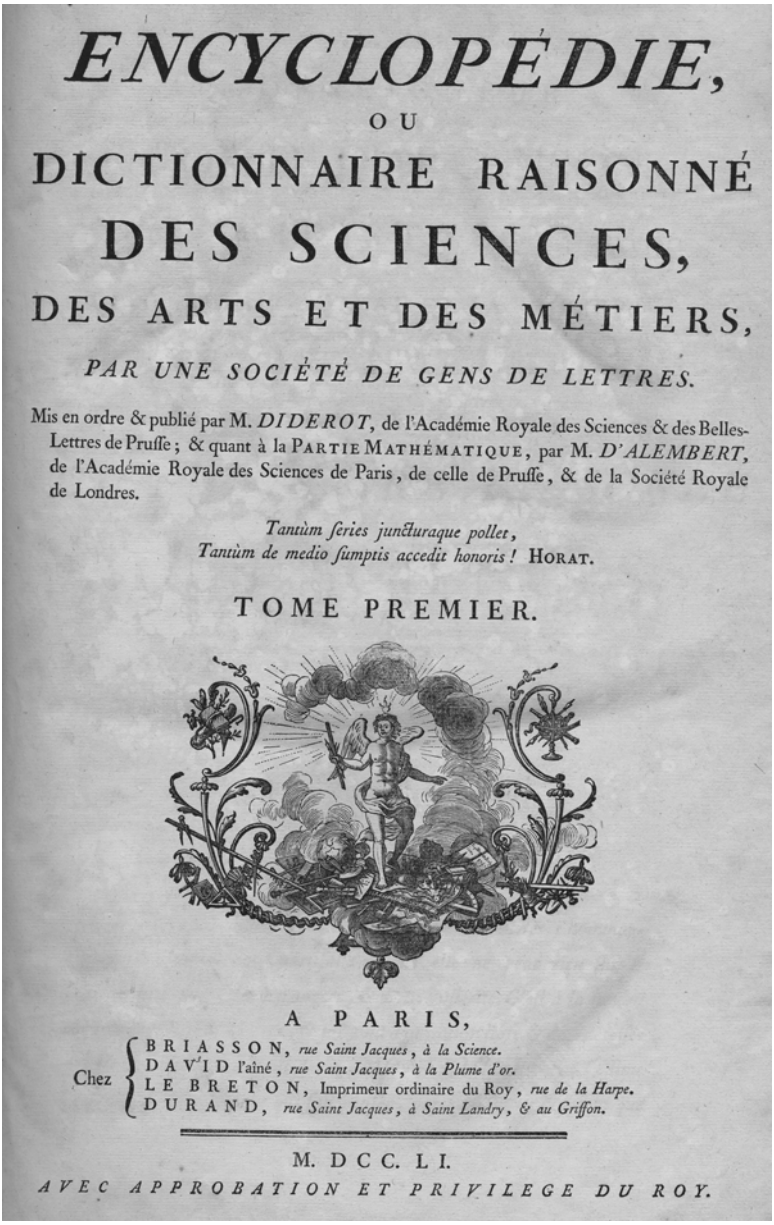
Fig. 13.3 Credit: From Nelson, *Computer Lib/Dream Machines* (Courtesy of Theodor Holm Nelson)

What Ted expressed in this passage from *Literary Machines* resonates strongly with what the Enlightenment philosophers understood the world of paper texts to look like, and, it resonates still more strongly with what they argued it *should* look like.

The philosophers of the Enlightenment understood the problem of knowledge as both a matter of seeing the world in a certain way and also of operationalizing that vision through technical mechanisms. The Enlightenment produced dozens of important new encyclopedias, dictionaries, concordances, atlases, and other interconnecting, non-linear, and non-hierarchical information tools, many of which you are certainly familiar with, even if you don't know much about their origins or early history. All of these eighteenth-century information devices were analog. Nearly all of them, with the exception of a few that had moving parts of one sort or another, ran on the platform of paper. What look to us like elegant, dusty old sets of volumes, looked to the eighteenth-century end user, like genuinely high tech devices. Because they were (Fig. 13.4).

Among the eighteenth-century works to really engage the intertwingling problem, the best, most ambitious, and most thoroughly theorized was certainly the *Encyclopédie: ou Dictionnaire Raisonné des Sciences des Arts et des Métiers* of Denis Diderot and Jean le Rond d'Alembert. The *Encyclopédie* was remarkable in every way. It was brilliant, employing the labors of the best writers of its day including luminaries such as Voltaire (1694–1778) and Jean-Jacques Rousseau (1712–1778). It was enormous, comprising 28 volumes, 72,000 articles by over 2,000 writers, and more than 3,000 plates. And it was formally rigorous, employing new systems of reference and cross-reference, making it as accessible as it was sophisticated. It was also, not incidentally, a great gesture of free-thinking, and for this it was censored, though the French censor in fact liked it very much and turned a blind eye when the work was smuggled into France.

The formal reference system embedded in the work was no mere convenience. Quite the opposite: Diderot and d'Alembert believed that their encyclopedia offered a response to an emerging crisis in the general field of information. Among other challenges, there was the perception of information explosion. The eighteenth-century world was awash in newspapers, journals, letters, bureaucratic documents, and books. Books, books, and more books. So many, it seemed, that contemporaries despaired at the prospect of mastering them all [4].


ENCYCLOPÉDIE,

OU

DICTIONNAIRE RAISONNÉ

DES SCIENCES,

DES ARTS ET DES MÉTIERS,

PAR UNE SOCIÉTÉ DE GENS DE LETTRES.

Mis en ordre & publié par M. DIDEROT, de l'Académie Royale des Sciences & des Belles-Lettres de Prusse; & quant à la PARTIE MATHÉMATIQUE, par M. D'ALEMBERT, de l'Académie Royale des Sciences de Paris, de celle de Prusse, & de la Société Royale de Londres.

Tantùm series juncturaque pollet,
Tantùm de medio sumptis accedit honoris! HORAT.

TOME PREMIER.

A PARIS,

Chez
BRIASSON, *rue Saint Jacques, à la Science.*
DAVID l'aîné, *rue Saint Jacques, à la Plume d'or.*
LE BRETON, Imprimeur ordinaire du Roy, *rue de la Harpe.*
DURAND, *rue Saint Jacques, à Saint Landry, & au Griffon.*

M. DCC. LI.

AVEC APPROBATION ET PRIVILEGE DU ROY.

Fig. 13.4 Frontispiece from the *Encyclopédie* of Diderot and d'Alembert (1751–1772) (Credit: Encyclopédie, ou Dictionnaire raisonné des sciences, des arts et des métiers, ed. by Denis Diderot and Jean le Rond d'Alembert)

In order to perceive the visceral dimension of this problem, you have to understand that, through the end of the seventeenth century, scholars continued to maintain the fiction that a true polymath could and should master all important literature, much as we still very recently imagined that brick and mortar libraries could effec-

tively serve our information needs. Today's information vertigo is parallel to that of the eighteenth century. Every period feels that it overloads something. The eighteenth century experienced a blowout of individual human memory, and in a flash, invented the wall of reference books we've only just recently seen dismantled.

As print flourished in the eighteenth century, the mnemonic ideals of the Renaissance seemed farther and farther distant. Without some sort of fix, Diderot and d'Alembert argued, books would simply pile up until, in their words, "It will be almost as convenient to search for some bit of truth concealed in nature as it will be to find it hidden away in an immense multitude of bound volumes." [2].

Their solution was qualitatively different from those proposed in our own period, including Nelson's design for Xanadu. Xanadu calls for an open and emergent structure of interlinked documents. The Encyclopedists, by contrast, built a mostly closed system: a single set of encyclopedias, emulating a literary universe. Of course, Diderot and d'Alembert built in mechanisms for external reference, revision, supplement, and so forth, but they designed the *Encyclopédie* to run flawlessly as freestanding system.

What were their innovations? Among others, they borrowed for their encyclopedia the alphabetical format of a dictionary. Older encyclopedias were generally organized hierarchically and by subject. Theirs was designed to be navigated by keyword, to allow readers to enter and exit at any useful point. Additionally, their encyclopedia was hypertexted. Articles were linked in a web through a system of *renvois* or cross-references. The *Encyclopédie* also offered a hierarchical subject map, echoing the structure of older works, but, in the work of Diderot and d'Alembert, the tree of knowledge was presented as only one of several heuristics.

Moreover, the *Encyclopedie* was illustrated with lavish, highly detailed, and meticulously annotated diagrams illustrating articles in the work and at the same time providing them with a visual index. Finally, the new encyclopedia was multiply authored, drawing on famous and obscure writers across many fields. Its authority did not derive from the prestige of a single great mind but from a socially distributed network, what they called, in an influential turn of phrase, a *société de gens de lettres*. Indeed, a large number of articles were unattributed or written under false names.

For our purposes, the central defining feature of this new encyclopedia is that it was, fundamentally and originally, conceptualized as hypertext, a characteristic ably explored by Gilles Blanchard and Mark Olsen at the ARTFL project at the University of Chicago, which had an interactive, digital version of the *Encyclopédie* up and running already in the 1990s around the time that I was first reading Nelson's books [1].

In Fig. 13.5 is a network diagram created by Blanchard and Olsen from the ARTFL *Encyclopédie* displaying the direction and density of some of the cross-references embedded in the work. This network diagram itself is, of course, not an artifact from the eighteenth century. At the same time, this modern diagram expresses a thoroughly conceptualized design logic implicit in the system of cross-references of the *Encyclopédie*. In the diagram, nodes represent topics identified by Diderot and d'Alembert; fatter lines show a higher number of links. The visual logic

Fig. 13.5 Map of renvois (cross-references) in the *Encyclopédie* of Diderot and d'Alembert by Mark Olsen and Gilles Blanchard (Credit: Courtesy of Mark Olsen and Gilles Blanchard)

of the diagram makes a strong contrast with the familiar branching tree diagram favored by the Encyclopedists as a mechanism for expressing a hierarchical relationship among academic disciplines. This very real contrast, however, should not be understood as a contradiction. The Encyclopedists understood hierarchy and intertwingulation as complementary and mutually inflecting perspectives. Each buttressed and improved the other (Fig. 13.6).

There is a great deal to say about the specific features of eighteenth-century thought illuminated by these diagrams. But above all, we see clearly that the hierarchical distribution of knowledge which many have considered paradigmatic of Enlightenment epistemology, is not only a pale shadow of the complexity present in it but is also a poor representation of what scholars and philosophers of the Enlightenment understood themselves to be doing. The Encyclopedists employed a system of cross-reference in order to solve a problem related to the actual complexity of knowledge while at the same time enabling new kinds of understanding and inquiry that were hampered by older literary conventions.

The Encyclopedists understood their project as both urgent and revolutionary. In their view, modern science and philosophy required a new interdisciplinary approach. Boundaries among the various arts and sciences were collapsing, and continued progress would only be possible with a further demolition of disciplines. Though Olsen and Blanchard's network diagram would not have been familiar to the generation of the Encyclopedists, the concepts behind it were. They too were

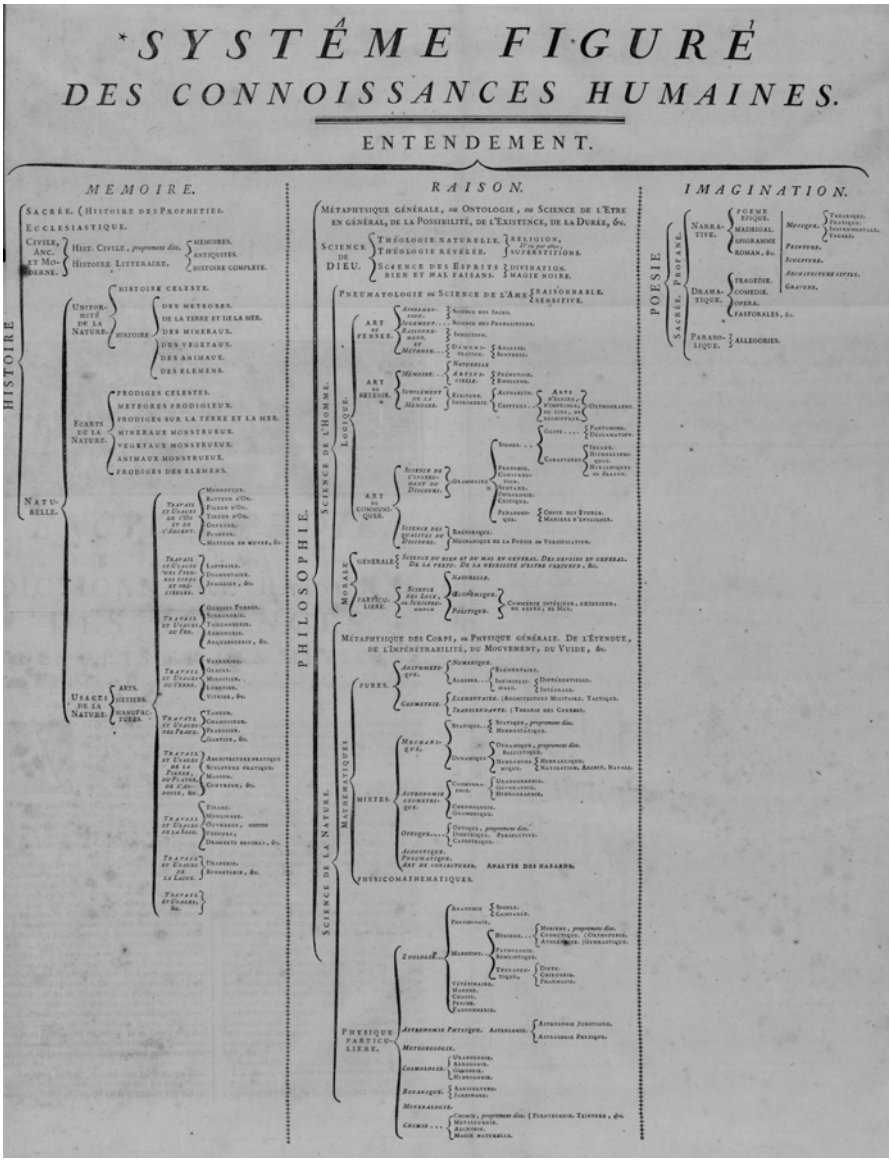


Fig. 13.6 Système figuré des connaissances humaines from the *Encyclopédie* of Diderot and d'Alembert (1751–72) (Credit: Encyclopédie, ou Dictionnaire raisonné des sciences, des arts et des métiers, ed. by Denis Diderot and Jean le Rond d'Alembert)

thinking about intellectual phenomena in terms of underlying structures and aggregate relationships.

In the *Chart of Biography* from 1765 (Fig. 13.7), for example, the renowned English scientist and theologian Joseph Priestley depicted the history of the arts and sciences as an "immense river" of time carrying along many individual contributors.

Fig. 13.7 Joseph Priestley, *Chart of Biography* (1765) (Credit: Courtesy of the Library Company of Philadelphia)

In real life—that is to say on paper—Priestley's *Chart of Biography* is large, about three feet long and two feet tall. The bottom edge is a timeline running from 1200 BC to 1800 AD, measured in regular intervals. The chart contains six big horizontal bands, each devoted to a general *category* of achievement [6].

The categories themselves are a fascinating artifact of their time, and a good reminder that, as many affinities as we may find between our world and the world of the eighteenth century, these are different times. In the top band of the chart, we find the Historians, Antiquaries, and Lawyers; below them are the Orators and Critics; then come the Artists and Poets; the Mathematicians and Physicians; the Divines and Metaphysicians; and finally at the very bottom, the Statesmen and Warriors. The interior area of Priestley's chart is filled to varying densities with about 2,000 solid black horizontal lines that begin and end at the dates for the birth and death of the figures depicted in the diagram (Fig. 13.7).

Priestley's system is another sort of hypertext. And his discussion of its hypertextual features is explicit. Each of the life lines on Priestley's chart refers to a particular person, as indicated by a name above it. But, given his druthers, Priestley would have hidden the names. A rollover feature might have worked very nicely. But with the technology of print, Priestley saw no other practical solution than to put the names on the chart in a very tiny font. As Priestley recognized, the distribution of names into categories was based on subjective judgment. Priestley's own biography was a case in point. A great figure in several fields, he could easily have been placed among the scientists or the theologians of his time. Still, Priestley ventured that the patterns visible on the chart revealed real historical phenomena, among which he highlighted two. And these will bring us back to our main argument and to Ted Nelson.

First, Priestley notes a difference between patterns in fields for the history of art and science compared with those for the history of politics and war. We see this for example in the contrast between the range devoted to the Mathematicians and Physicians (in other words, the scientists) and that devoted to the Statesmen and Warriors. From the changing densities of achievement discovered in the former, Priestley is able to spin out a story of the Classical, Medieval, and Renaissance periods. From the latter, nothing. In the realm of politics and war, from the beginning to the end of the historical record, Priestley finds abundance everywhere and no meaningful, patterned change at all. Here is how Priestley puts it, in a passage that I think it still resonates today:

> By the several void spaces between . . . groups of great men, we have a clear idea of the great revolutions of all kinds of *science*, from the very origin of it; so that the thin and void places in the chart are, in fact, no less instructive than the most crowded, in giving us an idea of the great interruptions of science, and the intervals at which it hath flourished.

By contrast, he says,

> We see no void spaces in the division of Statesmen, Heroes, and Politicians. The world hath never wanted competitors for empire and power, and least of all in those periods in which the sciences and the arts have been the most neglected.[2]

[2] Joseph Priestley, *Description of a Chart of Biography*, in John Towill Rutt, ed., *The Theological and Miscellaneous Works of Joseph Priestley*, 25 vols. (London: G. Smallfield, 1817–32) v. 24, p. 475 quoted in Daniel Rosenberg, "Joseph Priestley and the Graphic Invention of Modern Time," *Studies in Eighteenth Century Culture* 36 (2007): 68.

This was 1765. Not bad at all, I'd say.

Priestley's second point, closely related, is that historical advance in the arenas of art and science is not only real, it is also, finally, inevitable. For some in Priestley's period, this idea, the idea of progress, was a matter of faith. Priestley thought it was nothing more than a statistically supported analysis of history, an analysis embedded in the chart itself.

Priestley believed that the largest present impediment to progress in ideas was the cloistering of knowledge within small domains, whether languages, nations, or disciplines. He argued that his chart showed that by the latter part of the eighteenth century, all of those barriers were falling and the acceleration of progress had become irresistible. And yet, there were dilemmas. As we know so well in our own period, acceleration of information production brings problems all its own. And this is one of the reasons why we find in the eighteenth century such a tremendous diversity of works employing new strategies of data compression and display such as the *Chart of Biography* and the *Encyclopédie*, themselves.

I don't want to overstate the resemblance between the eighteenth-century moment and our own. There is a resemblance. However what matters is not similarity but connection. The textual strategies of the eighteenth-century encyclopedia and the display strategies of eighteenth-century infographics are only two examples of a very large set of information tools that we not only continue to use today—and by the way, many other staples of our infographics such as the line graph and the bar chart are eighteenth-century confections—but that we think of, in their re-invented electronic form, as hallmarks of our own information consciousness.[3]

Part of what has always set Ted Nelson's work apart is its sensitivity such to historical predecessors. Nelson's has always been a distinctive futurism, rich in appreciation of what works in traditional information mechanisms (and especially those of the paper world), yet impatient with dogmatism and with low-dimensional approaches to knowledge. For me, the key to Nelson's work has always been his aphorism "Literature is debugged" [3].

The idea, deceptive in its simplicity, is that literature in its most "traditional" sense embodies and operationalizes any number of systems that may be theoretical, social, linguistic, and above all textual, that, whatever else we may say about them, they have proven, over the course of centuries, functional, durable, and adaptable. In other words, they have *worked*. This is a good quality for any technology.

To paraphrase Louis-Sébastien Mercier—one of our eighteenth-century informants and, not incidentally, author of one of the world's first future fictions, *L'an 2440, rêve s'il en fut jamais* (1769)—it is a dream if there ever was one, the notion that an information system we build today could still be running three hundred or

[3] Early modern antecedents to today's information universe are explored in different respects in many recent works including Ann Blair, *Too Much to Know: Managing Scholarly Information Before the Information Age* (New Haven: Yale University Press, 2010); Markus Krajewski, *Paper Machines: About Cards & Catalogs, 1548–1929*, trans. Peter Krapp (Cambridge: MIT Press, 2011); Edward Tufte, *The Visual Display of Quantitative Information* (Cheshire, CT: Graphics Press, 1993).

more years from now. And yet this is the case for printed reference works, of which eighteenth-century encyclopedias and timelines are great monuments.

The notion that "literature is debugged," then, should not be taken to mean that "traditional" literature or literary systems are problem-free. In fact, Nelson's books all contain strenuous critiques of received practices, foremost among them, that of presenting information in inflexible hierarchical and linear structures. Nelson has sometimes grouped these criticisms under a rubric he calls the "school problem." [3] The Encyclopedists, thinking in parallel terms, called it the problem of "scholasticism." For them, as for Nelson, Aristotle was one of the principal demons to slay.

The scholastic attitude is sometimes embodied in *textual forms*, but, as the non-linear and interlinking structure of the eighteenth-century encyclopedia demonstrates, it is in no way inherent to print. As I have already suggested, there are dozens, even hundreds, of examples, of traditional textual and diagrammatic forms designed specifically to facilitate non-linear and non-hierarchical thinking. Yet regular discourse, as was implicit in my previous sentence, shows off these very same characteristics. As Nelson [3] points out,

> Many people consider [hypertext] to be new and drastic and threatening. However, I would like to take the position that hypertext is fundamentally traditional and in the mainstream of literature. Customary writing chooses one expository sequence from among the possible myriad; hypertext allows many, all available to the reader. In fact, however, we constantly depart from sequence, citing things ahead and behind in the text. Phrases like "as we have already said" and "as we will see" are really implicit pointers to contents elsewhere in the sequence.

Among technical devices designed to facilitate the sort of jumping that narrative language performs as a matter of course (though with limited flexibility) one might mention, for example, indexes, tables, file cards, and so forth. And of course, contemporary information designers *do* think about all of these things. Nelson's own recent efforts to reimagine database design fall into this category of work. All of this was prefigured in his print works from the multiply-folded *Nothing* literary magazine he published at Swarthmore to the hopscotched, inverted, and mutually dependent texts of *Computer Lib/Dream Machines*, to the choose-your-own-adventure numbering of *Literary Machines*, as well as the tea leaf patterns of Xanadu and the fractal explosions of ZigZag.

The phrase, "literature is debugged," should not be taken to mean that we cannot improve on old systems, but rather, that it is essential to notice *how*, for better and worse, old systems function. This is, of course, the sort of thing a historian is not unhappy to contemplate (Fig. 13.8).

There is so much that we can and must take from Nelson's writing. For me, Nelson's work functions as an injunction to attend to our information ancestors, while not indulging in worship. For humanists, in general, I think it should be read as a call to study old literatures *as systems*, something an encouraging number of humanities scholars are now beginning to do.

Fig. 13.8 The Apotheosis of Computer Lib (Credit: Adapted from Theodor Holm Nelson, Computer Lib/Dream Machines and Encyclopédie, ou Dictionnaire raisonné des sciences, des arts et des métiers, ed. by Denis Diderot and Jean le Rond d'Alembert)

References

1. Blanchard G, Olsen M (2002) Le système de renvoi dans l'Encyclopédie: Une cartographie des structures de connaissances au XVIIIe siècle. Recherches sur Diderot et sur l'Encyclopédie 31–32:45–70
2. Diderot D (1751–72) Encyclopédie. In: Diderot D, d'Alembert JLR (eds) Encyclopédie, ou Dictionnaire Raisonné des Sciences, des Arts et des Métiers par une Société de Gens de Lettres
3. Nelson TH (1981) Literary machines: The report on, and of, Project Xanadu concerning word processing, electronic publishing, hypertext, Thinkertoys, tomorrow's intellectual revolution, and certain other topics including knowledge, education and freedom. Theodor H. Nelson, Swarthmore
4. Rosenberg D (2003) Early modern information overload. J Hist Ideas 64:1–9
5. Rosenberg D (2005) Electronic memory. In: Daniel Rosenberg and Susan Harding (eds) Histories of the future. Duke University Press, Durham, pp 125–52
6. Rosenberg D, Grafton A (2010) Cartographies of time. Princeton Architectural Press, New York